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THE TECTONIC STRAIN THEORY AS AN EXPLANATION FOR UFO PHENOMENA: A NON-TECHNICAL REVIEW OF THE RESEARCH, 1970–1990

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Unidentified flying objects (UFOs) is a contemporary term that has been applied primarily to anomalous luminous phenomena (ALP). They display odd movements, emit unusual colors or sounds and occasionally deposit physical residues. When these phenomena closely approach a human observer, exotic forces and perceptions are frequently reported. Most ALPs display lifetimes in the order of minutes and appear to show spatial dimensions in the order of meters. Despite their remarkably similar descriptions over time and across cultures, the transience and localized occurrence of these phenomena have limited their systematic investigation.

Explanations for these phenomena have ranged from social misperceptions and delusions to some variant of mystical or extraterrestrial intelligence. However, the only testable concept that has been formulated to date is the Tectonic Strain Theory or TST. It states that *most UFO phenomena* (not due to frank misobservation) *are natural events, generated by stresses and strains within the earth's crust.* The phrase "most UFO phenomena" is emphasized because the primary measurement is still human observation and classification. Due to their limitations, overinclusion of events or experiences that are not coupled to tectonic stress or strain are expected. Highly unlikely but nonetheless possible episodes of extraterrestrial sources could be contained within that residual.

The TST was originated from inductive rather than deductive processes; the data themselves revealed the principle that allowed the development of the theory. Between 1969 and 1972 the several thousands of events referenced by Charles Fort were designated to several dozens of categories (Persinger 1976; Persinger and Lafrenière 1977). Because we assumed that transient, anomalous, and dynamic phenomena required substantial sources of energy, measures of intense displays such as tornadoes, earthquakes, and weather extremes were included in the analyses. The most consistent and strongest correlations in time and space occurred between what Fort had labelled "luminous phenomena" and the numbers of earthquakes. At about the same time we were completing these analyses, Paul Devereux had begun his field research and John Derr had focused upon the intriguing problem of earthquake lights.

A basic scientific motive, the understanding of nature and of the hidden mechanisms within it, has stimulated the development of the TST; it was never intended to serve a debunking function. The pursuit also has been encouraged by the prospect of practical application. If ALP are indices of tectonic strain and it generates earthquakes, then the possibility existed that some form of ALP, such as UFO reports, could be used to help forecast the locality or occurrence of earthquakes. A necessary consideration of the TST, although not directly related to its verification, is the consequence of both ALP and the belief concerning their origins upon human behavior and attitudes. They are often as important to scientific discovery as the physical principles themselves.

Large-Scale Application of the TST

The TST predicts that most ALP and their contemporary equivalent, UFOs, are generated by natural geophysical forces. The major source is tectonic stress; it is primarily a consequence of the slow cooling of the earth. The stress occurs continually as a field within the earth's crust. However, the direction and magnitude of stresses change over space and time. These changes induce strain within the local crust. In general the stresses are focused and the strain is induced within areas that contain the optimal geological architecture or that have traditionally undergone strain release. They include faults, rifts, many river systems and localities of enhanced compressional deformation.

As stresses accumulate over time, UFO phenomena are generated. Generally there is a critical magnitude of stress that precipitates a sudden, substantial release in the strain energy: this is called an earthquake or a seismic event. According to the TST, *detectable earthquakes do not cause most UFOs. Instead, both UFOs or ALP and earthquakes are generated by the same process: earth stress.* Because earth stresses generally escalate over several months to years before earthquakes, most UFO reports should precede earthquakes. However, variations in local stresses frequently follow strong seismic events; consequently a small proportion in the numbers of UFOs should occur during these adjustment periods.

There should also be a temporal distribution of UFO reports within the 24-hour period preceding and following significant releases of seismic energy. These ALP occur and have been called earthquake lights. If these ALP are generated by the same process that produces UFOs, then their properties should be similar. Even within classification systems (Galli 1910; Terada 1931) that were developed before the classic UFO period, the remarkable similarities between earthquake lights and UFO phenomena are evident. Major classes of earthquake light include luminous masses (some of which appear to rotate on axes); football- or lantern-shaped fireballs; metallic-looking forms; luminous columnar, funnel, or trumpet shapes; and sprinkles. Comparable ALP are still reported today. The most recent earthquake-related ALP were documented by Marcel Ouellet (1990). They occurred around the Saguenay region of Quebec and were associated with the intense earthquake of November 25, 1988.

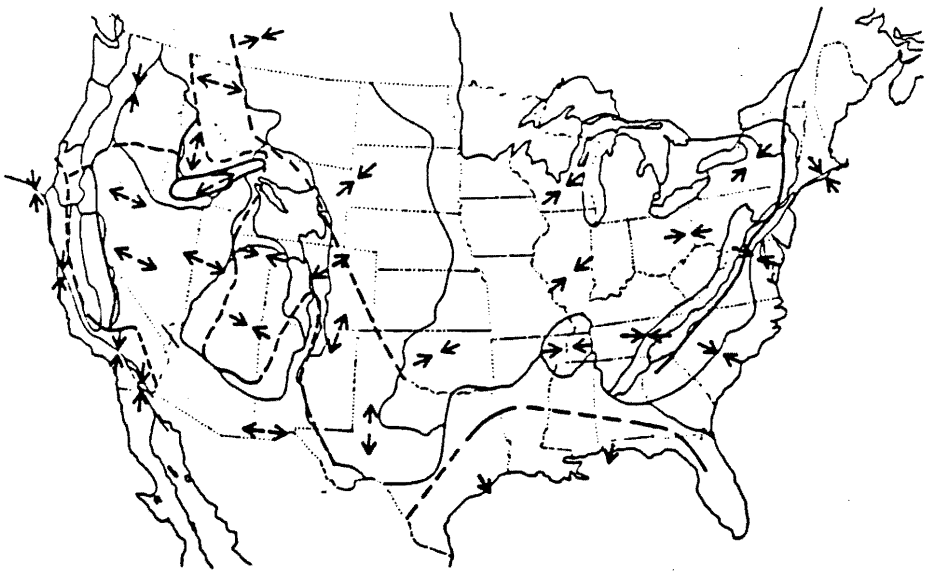

Fig. 1. Distribution of tectonic stress directions within the crust in the United States according to the hydrofracture technique (modified by Zoback and Zoback 1981).

At this level of analysis, the TST's major limitation is similar to that encountered by any process that cannot be measured simultaneously in one place at a particular time. Although general patterns in tectonic stress can be interpolated using a variety of methods (Zoback and Zoback 1981), the simplest measure for analysis is the occurrence of discrete events that can be counted: earthquakes. Because the occurrence of earthquakes and, more specifically, the energy released by seismic events is assumed to generally reflect the amount of stress within the region, these measures are used to infer tectonic stress. Effectively the amount of energy release has been used as an index of strain. An analogous difficulty occurred in meteorology before the dense spatial grid of weather stations was established. Without the optimal instruments (barographs) and continuous measurements over multiple locations, the concept of a low pressure air mass could not have been envisioned or documented.

Despite the limit of direct strain measurement, there are precise extrapolations that can be generated and tested:

1) Because tectonic stress is never zero, UFO reports can occur anywhere but should occur more frequently in geological regions undergoing increases in stress accumulation (Fig. 1).

2) Because stress accumulation occurs gradually over time and then is associated with a sudden release, most UFO reports should precede increases in earthquake activity; in those areas in which strain continues to occur after a quake, UFO reports could also occur but their numbers should be diminished unless another major release of energy is imminent.

3) Historical equivalents of UFO reports should have occurred frequently, especially in regions that have maintained earth stresses over decades or centuries ("window areas").

4) Because UFO phenomena are generated by geophysical processes, the understanding and perception of UFO reports as a phenomenon is only evident within the spatial and temporal time frames required to understand seismic process, i.e., hundreds to thousands of square kilometers and months to years.

5) Any process or event that affects seismicity should affect the numbers of UFO reports; because some forms of seismicity are coupled to the solar cycle, UFO reports should reflect this periodicity or a subset of it, such as a single intense flare. Local factors, including large-scale fluid injection into the crust or stress shifts (changes in major river, lake or reservoir volumes), could trigger episodes of ALP and UFO reports.

(a) Data and Procedures of Analyses

Since 1979, approximately 20 technical articles have been published that support the validity of the TST as an explanation for most reports within UFO or ALP databases from a number of different places. There have been two major approaches to the problem. The first involves "local" episodes of reports within a diameter of 50-100 km; they include the Salisbury Uinta Basin episode during 1967 (Persinger and Derr 1985a), the Long-Vogel-Akers Toppenish Ridge Sightings between 1973 and 1977 (Derr and Persinger 1986), the Rutkowski Carman, Manitoba, occurrences between 1974 and 1977 (Persinger and Derr 1985b), the Rutledge New Madrid field study of 1973 (Persinger, 1988a) and the Zeitoun, Egypt, phenomena that were reported during the years 1968 and 1969 (Derr and Persinger 1989a).

The second approach involves larger areas of space. These analyses have included the central-eastern U.S.A. record between 1945 and 1966 (Persinger 1980, 1981a, 1983a), the Washington-Oregon analyses (Persinger and Derr 1984), the Charles Fort United Kingdom period between 1850 and 1920 (Persinger 1983c), the New Madrid Region 1945-1977 analyses (Persinger 1981b, 1983b), the 1965 to 1977 Swedish series (Mattsson and Persinger, 1986), the central U.S.A. 1947 to 1966 period (Derr and Persinger 1990a) and the Rio Grande Rift (New Mexico-Colorado) area (Derr and Persinger 1989b; Persinger and Derr 1990). With the exception of the United Kingdom, New Madrid Region, and Mattsson sources, the data for these analyses were obtained from the Center for UFO Studies (CUFOS).

Initially the analyses involved numbers of UFO reports and numbers of different intensity (Mercalli) earthquakes per unit time. In response to suggestions by John Derr and Chris Rutkowski, two major shifts in conceptualization have been employed. First, measures of seismic energy release replaced the use of numbers of earthquakes. The reasoning was simple. Release of seismic energy is more theoretically related to strain release than the numbers of earthquakes. If UFO reports are related to strain, then changes in their occurrence must be related to the amount of seismic energy

release. Secondly, discriminative validity was pursued. Although most UFO reports are likely to be natural, geophysical phenomena, databases are probably heterogeneous collections of human experiences. By differentiating between likely sources of ambiguous observations from more robust descriptions, in a manner similar to the strangeness scale employed by David Saunders for the CUFOS data, classic UFOs and ALP should be most correlated with indices of seismicity.

For the local studies, three major questions were asked:

1) is there a significant correlation between earthquake numbers (or energy release) and the numbers of UFO reports?

2) what is the distance of earthquakes that are most correlated with UFO reports?

3) what is the temporal relationship between the occurrence of the UFO reports and the occurrence of the seismic energy release?

To minimize the problems that occur by including the extremes of temporal distributions of data, most analyses were completed for the intervals in which the cumulative numbers of UFO reports were relatively linear. Usually, approximately 90% of the reports within a collection occurred within this period.

Increments of one month have been used primarily because the duration of the databases were relatively brief, i.e., in the order of years. The numbers of earthquakes (or the amount of energy release) per month was compared with the numbers of UFO reports or ALP per month. To determine the optimal distance of earthquake inclusion, correlational analyses were completed that incorporated earthquake measures from successively increasing distances from the focus of UFO reports until the magnitude of the correlation coefficient peaked and then deteriorated. Determination of the optimal temporal relationship between numbers of UFO reports and earthquakes was completed by the lag-lead procedure. Multiple regressions were completed between the seismic measures per month and the numbers of UFO reports or ALPs the same month or each of the three months before or afterwards.

The second approach utilized much larger areas. Numbers of UFO reports or ALP per six-month increment (usually January-June, July-December) were correlated with the numbers of earthquakes or the amount of energy released during the same increment and for each of three increments before and afterwards. For control analyses, seismicity of the surrounding area was often included. Contrary to the critique of Rutkowski (1984) and Rutkowski and Del Bigio (1989), all of these procedures include routine analyses and are neither complicated nor contrived; they do require a rudimentary understanding of problem solving. Over the last 10 years the following major patterns have been found.

(b) Spatial and Temporal Relationship Between UFO Reports and Seismicity Are Most Evident Within Geophysical Units

Except for some peak periods in UFO reports, a simple relationship in time between their numbers per day and the numbers of earthquakes are rarely statistically significant or obvious. Retrospective studies strongly suggest that a rapid onset of

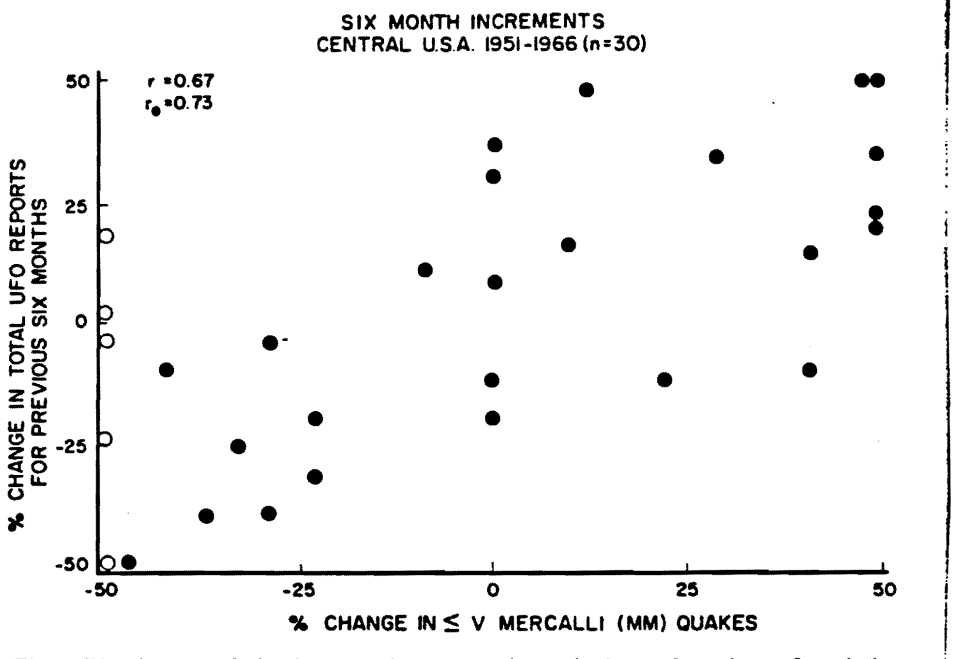

Fig. 2. Bivariate correlation between the percent change in the total numbers of weak (less than intensity VI) earthquakes within the central U.S.A. and the percent change in total numbers of UFO reports (from the previous increment) for the six-month periods before the change in earthquake activity. The two r values refer to inclusion or not inclusion (closed circles) of values that were truncated at -50%. The effect is analogous to a derivative or rate of change in seismic activity, one discrete index of tectonic stress.

ALP and UFO reports have occurred during the approximately 10 days before some unexpected (no obvious seismological precursor) strong earthquakes in a region. Within 1) large areas at the level of states or regions in the U.S. and smaller countries in Europe, and 2) six-month increments of analyses, the correlations are almost always statistically significant. When temporal increments that exceed 1 to 2 years are employed, the strength of the correlation weakens. When the area of inclusion exceeds regional geological boundaries of seismic patterns, the coefficients are diluted.

For six-month increments, the magnitudes of the coefficients between numbers of seismic events and numbers of UFO reports have ranged between 0.50 and 0.70 and usually involved 15 to 20 years (30 to 40 cases) of successive intervals. For fixed six-month analyses the strongest coefficients have been between the numbers of earthquakes and the numbers of UFO reports during *the previous six-month interval.* These results support the hypothesis that both UFO reports and earthquakes are caused by stress and that UFO reports are generated by the temporally evolving processes that precede and create earthquakes (Fig. 2).

More recent analyses of the Rio Grande Rift System (Fig. 3) and the central United States indicate that the numbers of UFO reports were significantly correlated (0.60 to

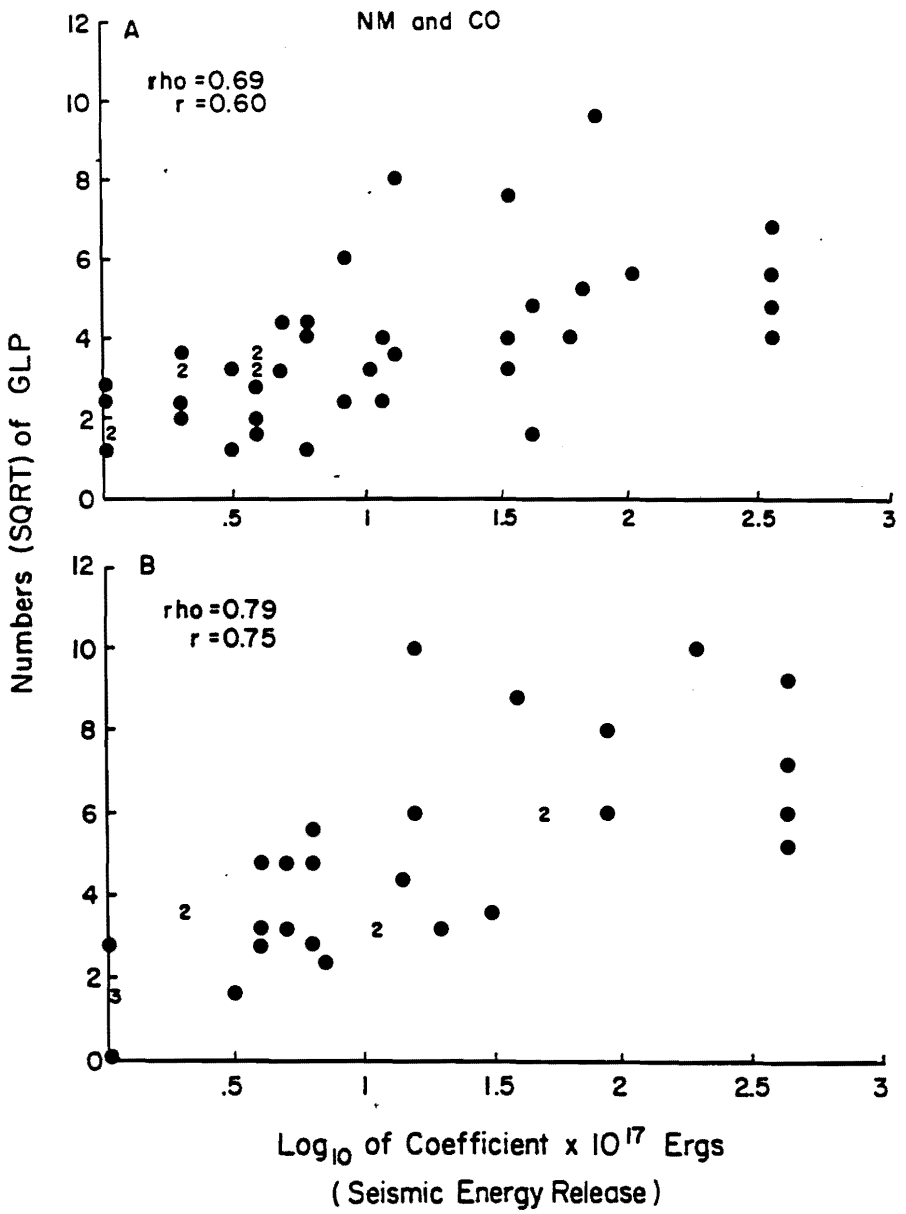

Fig. 3. (A) Bivariate correlations (Spearman rho and Pearson r) for the square root of the numbers of general luminous phenomena (GLP) and the amount of energy release per optimal fixed six-month interval in the region of the Rio Grande Rift System (New Mexico and Colorado) between the years 1947 and 1970. (B) Bivariate correlations between numbers of GLP and release of seismic energy per optimal (variable) interval within the same area.

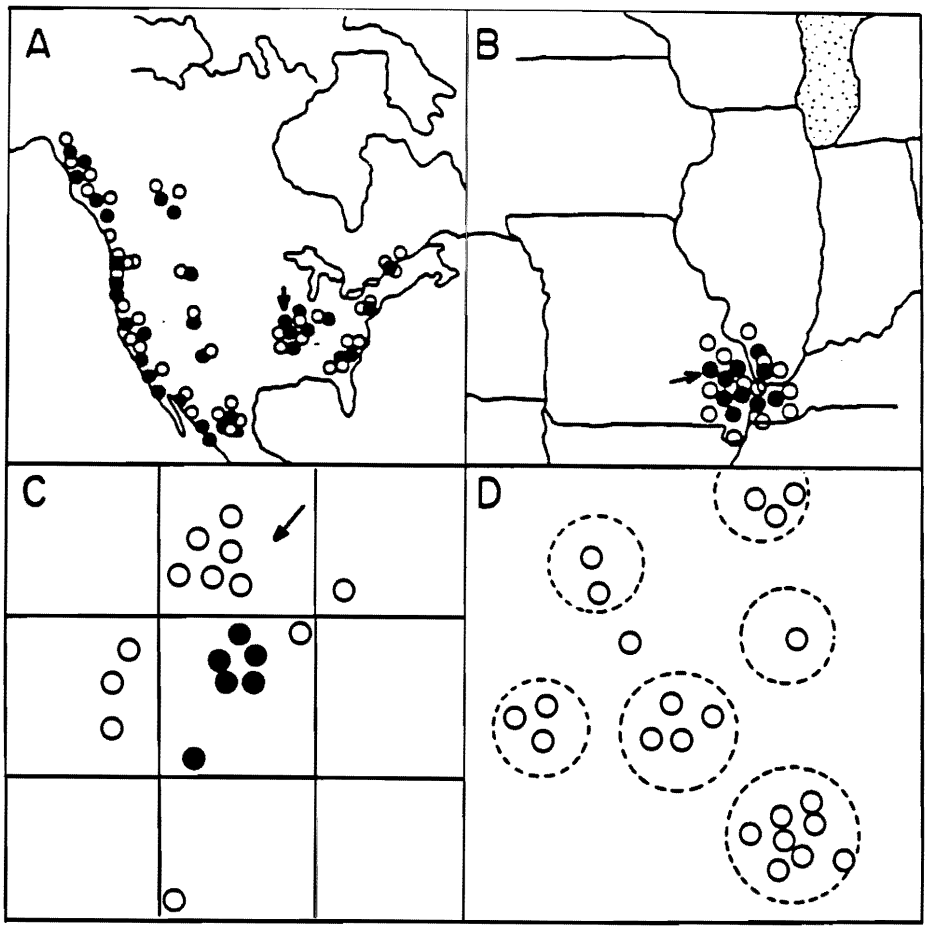

Fig. 4. Graphic demonstration of the importance of the optimal spatial increment of analysis in order to perceive the relationship between UFO (open circles) and earthquake activity (closed circles). Overinclusion of different geological regions (A) would obscure regional variations. Temporal analyses at perspective B would reveal the maximum relationship between the two phenomena. At finer spatial resolutions (C), the UFO reports and ALP may actually be spatially displaced from epicentral activity and hence the association may not be conspicuous. Level D would reflect still finer resolutions, typical of an investigation area by a single field researcher, of the open circles of C. Within these areas, indicated by the dotted circles in D, different discrete UFO events would occur. Because their spatial occurrence will be determined by local factors, the pattern may appear random.

0.75) with the *amount of seismic energy release* within the region but *not within surrounding regions* that served as control areas. For these studies and for the Denver (Derby) episode between 1962 and 1967 (Derr and Persinger 1989b), substantial increases in UFO reports occurred when the imminent energy release exceeded 1×10^{17}

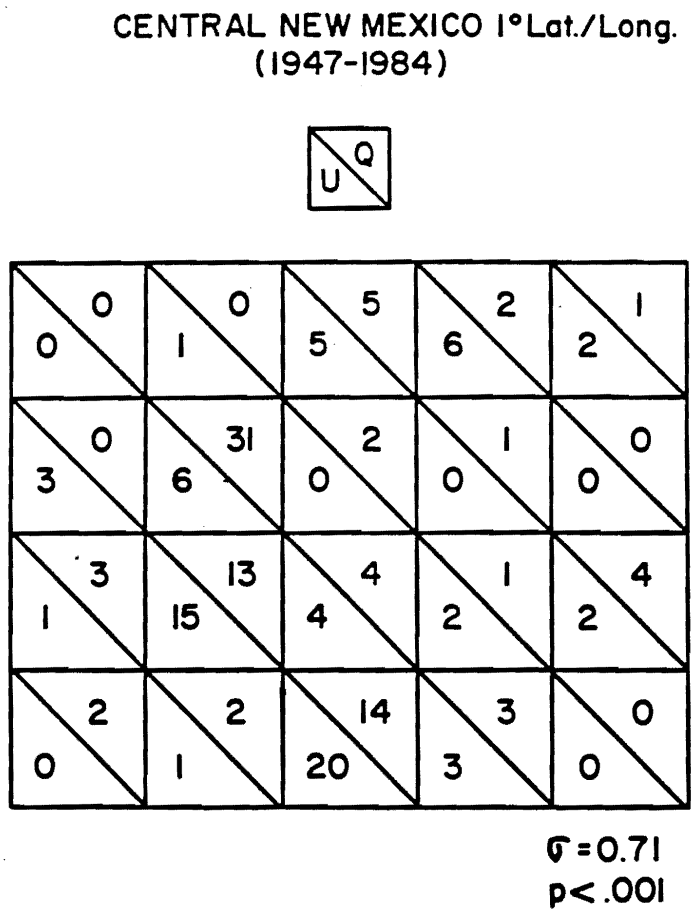

Fig. 5. One example of the spatial correlation between numbers of earthquakes within New Mexico between the years 1947 and 1984 and major UFO episodes as defined by the CRUX database. At the optimal spatial increment of analyses, 1 degree latitude and longitude, the correlation in space over this time interval was moderately strong (0.71). As the spatial increments become larger or smaller, the strength of the relationship decreases.

ergs within a six-month period or some variant of it. Because natural forces do not conform to arbitrary temporal increments (6 months) of analyses, the UFO-energy relationship is likely to be higher; in fact, with variable interval analyses that optimally partition continuous intervals into increments of shared variance, the correlations between numbers of ALP and the amount of seismic energy release were marginally higher (0.70 to 0.80).

Even when the "local" episodes of UFO reports are analyzed, the optimal increments of analyses still involve months and the distances include hundreds of square kilometers. In all six of the these analyses, the UFO flap that generated the recordkeep-

ing was associated with the most energetic seismic release in the region. Although the number of localities are too small to be conclusive, it is interesting that the optimal distances of earthquake inclusion that were required to obtain the strongest correlations between UFO reports and seismicity involved between 100 and 200 km within the Western U.S. and between 500 and 700 km for the central U.S.

These patterns support the hypothesis that the organization of the crust may in large part determine the effective "region" for analysis. In areas such as the western U.S. (Uinta Basin, Toppenish Ridge) the crust is a collection of small accretions, whereas in the central U.S. the crust involves a much larger plate that may be affected by extreme load variations on major river systems. This variability in the earth's crust must be accommodated in order to test the TST appropriately.

Determination of the optimal increment of space and time in order to perceive a phenomenon is a routine procedure in science. In order to perceive the gestalt of a mountain, one must not be too close or to distant. In order to perceive the action potential of a neuron, the increments of time must be neither too brief (or the event is displayed as a horizontal line) nor too expanded (or the event transmutes into a vertical line). If UFO phenomena are coupled to geophysical processes, then the causality would be most apparent when the dimensions and temporal properties of the local stress fields are identified.

What does such a temporal and spatial perspective imply for UFO research? Fig. 4 suggests the consequences. At too large a level of analyses, several strain fields are included and the maximum relationship may be obscured. At the optimal level, the relationship becomes clear (Fig. 5). However, as the spatial frame is reduced to the level of the local researcher and the time frame approaches the duration of human interest and activity, the relationship between UFO reports and earthquake activity is totally dissociated. Without fixed and reliable stations of data collection, in a manner similar to those required for weather forecasting, the picture will continue to be fragmented.

(c) Equivalents of UFO Phenomena Have Occurred During Historical Periods of Tectonic Stress Release

Although the term flying saucer and UFO emerged around 1947, UFO phenomena existed long before this period. Because human reports of anomalous phenomena are affected by the beliefs and expectations of the period, these phenomenon have been obscured. For example, before the earthquake of 1663 in Quebec, people saw "fires, torches, and flaming globes, which sometimes fell to the earth and sometimes dissolved in the air . . . they saw fires of this sort five or six times at night." "Terrible specters" were also seen. Not surprisingly, there were the more strange antecedent psi-like experiences such as: "wakening in her cabin while all other slept, she heard a distinct and articulated voice that said to her, 'In two days, marvelous and astonishing things will come to pass.'"

Comparisons of the numbers of UFO reports after 1947 with Fortean accounts of "odd luminosities" before 1920 for three regions: western Europe (Persinger 1983d, 1984a), the United Kingdom (Persinger 1983c) and the central U.S. (Persinger 1983e) have shown that both UFO reports and ALP were correlated with increased seismicity and energy release. Empirical equations generated from LP and seismicity within Western Europe between 1850 and 1920 predicted peaks in these events between the years 1930 and 1970; these peaks corresponded with the "foo fighter" and UFO flaps. For the central U.S., the opposite procedure was employed. Multiple regression equations were determined empirically between the numbers of UFO reports and seismic events for the years 1950 through 1975; standardized measures were then applied to periods (1860 to 1945) before that time. Predicted peak periods of UFO reports were associated with Fortean reports of LP as well as the infamous mysterious airship episodes.

Although the 1896-1897 airship episode is certainly anecdotal and has been considered a hoax by some researchers, the geophysical conditions that were associated with the airship episode are commensurate with both the hypotheses and corollaries of the TST. Approximately 80 to 900 of these reports of odd lights and "airships" occurred at night. One of the greatest floods to have affected the Midwest occurred during the spring of 1897, stressing regional river systems. Between January and May 1897, reports occurred within dozens of central and eastern states. The events were associated with the interval in which unusually intense earthquakes had been occurring (in inference of major stress) within the region and were terminated during the last of April; on May 31, the intense Giles County, Virginia, earthquake struck.

(d) Solar-Geomagnetic Factors Modulate Seismic Activity and Hence Affect the Occurrence of UFO reports in Strained Areas

The presence of a moderately strong temporal relationship between the approximately 11-year cycle in solar activity and terrestrial earthquakes is apparent in some seismic databases (Mazzarella and Palumbo 1988). Deep earthquakes appear to be significantly affected by solar acceleration, while more shallow ones are not (Jakubcova and Pick 1986). More precise analyses indicate that only specific types of earthquakes, depending upon the type of fault system and the level of stress accumulations, may be maximally affected by some factor associated with solar activity. As Louis Winkler has shown with several unpublished analyses, the role of solar activity in the occurrence of both earthquake lights and UFO reports may be more important than now predicted.

The most likely "factor" is geomagnetic activity. The majority of the variance in short-term (minutes to days) variation in the geomagnetic field are changes in either speed or density of the solar wind; these parameters are a function of solar activity. Geomagnetic activity is measured by referenced scales such as the Ap or aa indices. Within 6-month timeframes, the variability in global geomagnetic activity is associated with the numbers of UFO reports and they are associated with earthquake activity

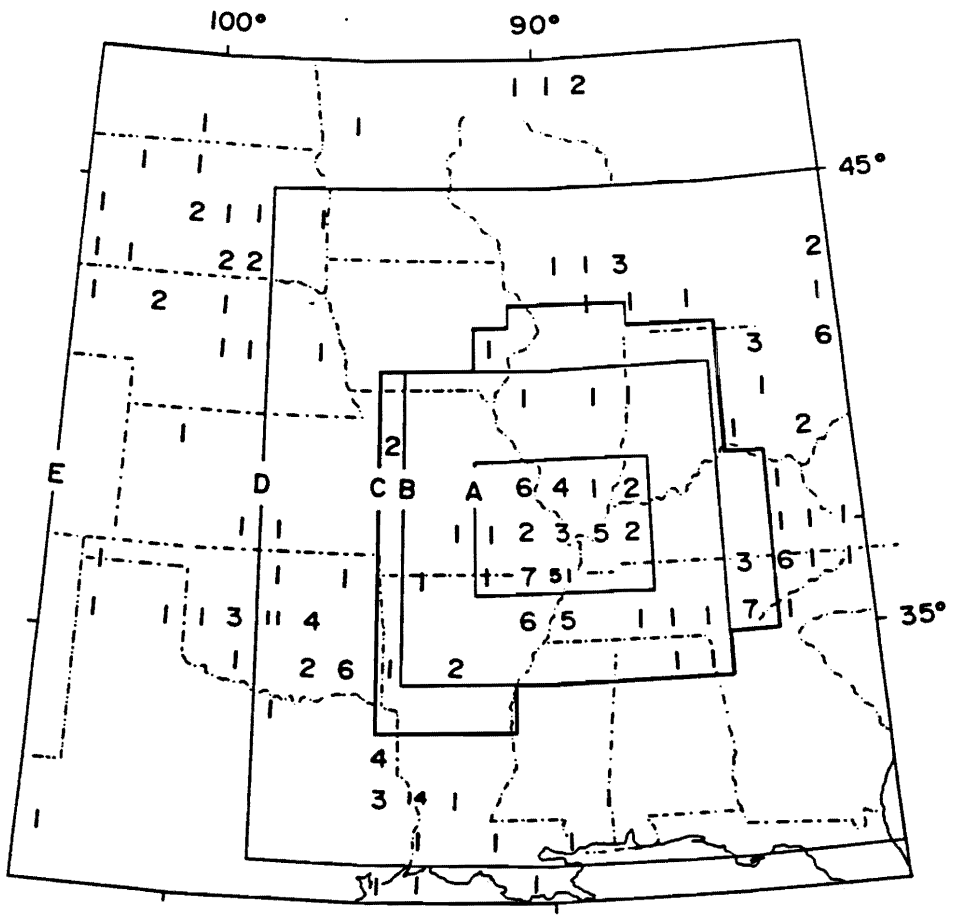

Fig. 6. Numbers of earthquakes recorded (Nuttli database) within various regions indicated by the letters A through E within the central and surrounding U.S. during the years 1947 through 1966.

during the following six months. However, the geomagnetic correlation with UFO reports is not significant if the variance they share with imminent earthquake activity is removed (Persinger 1985). This result suggests that *extreme variability in geomagnetic activity facilitates the numbers of UFO phenomena within a region but only if strain is present,* as defined by the later occurrence of earthquakes. During the Toppenish phenomena, ALP were significantly more likely to occur within months when single daily Ap indices exceeded 100 (extreme intensity), but only if nearby seismicity was increasing.

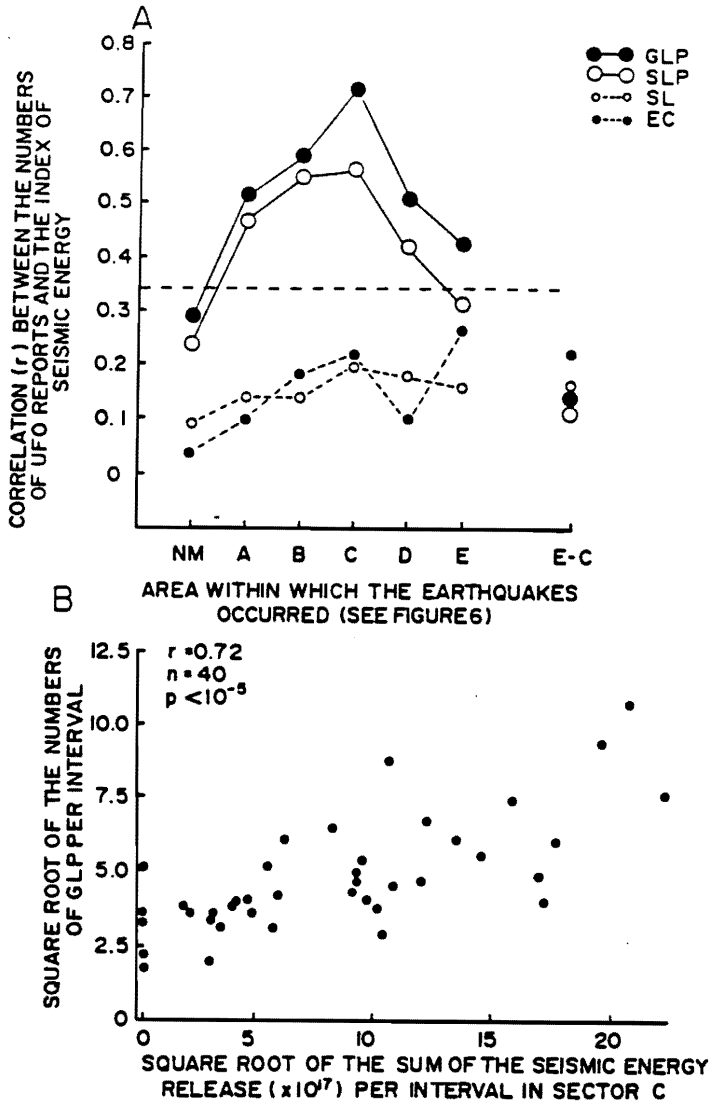

Fig. 7. (A) Correlations between different classes of UFO reports: GLP (general UFO reports; unclassified and types III through VI), SLP (specific luminous phenomena; types III through VI), SL (sky lights, types I and II) and EC (exotic cases, types VII through the most strange) within the central U.S. as defined by area C and the *amount of seismic energy release* per interval (about 6 months) within areas A through E; NM refers to the New Madrid (indicated here by the n=51 seismic events) Locus. E-C indicates the correlation between the various UFO reports and the energy release in the area surrounding (the "control" area) the region from which the UFO reports were recorded. Note that only GLP and SLP, which constitute more than 90% of the numbers of UFO reports, are significantly correlated with energy release. The effect is greatest for energy released within the same region within which the UFOs were reported.

(e) Sites of Major Fluid Injection May Serve as Quasiexperimental Demonstrations of the TST

Most of the empirical support of the TST has been correlational analyses. Although techniques of discriminative or convergent validity (Anastasi 1976) can be applied to insure the specificity of the relationship between ALP and earthquakes (Figs. 6 and 7), most scientists prefer experimental designs that allow control of the key variables. Man-made induction of earthquake activity by flooding, fluid injection, or irrigation can serve as potential quasi-experimental verifications. There are many anecdotal candidates that suggest the feasibility of this approach. An example is the temporal relationship between the massive irrigation causing the slow depletion of the Aral Sea (in the Soviet Union) and the nearby Tashkent seismicity and earthquake lightning.

Some of the most well-known events in the U.S. were the Derby quakes; approximately 1,000 of these quakes were evoked during the years 1962 through 1967 near Denver, Colorado, due to injection of several tens of millions of gallons of toxic fluid into the bedrock. Once the quakes were initiated, they appear to have continued, despite curtailment of injection, resulting in the most energetic seismic events of the region. These events were studied extensively. Correlative with this energy release were an unprecedented number of UFO reports within the Denver area.

Last year John Derr and I analyzed the monthly occurrence of ALP within 100 km, between 101 and 250 km and more than 450 km (used as the control region) from Derby. Within the Derby region ALP were positively correlated with the volume of fluid injection of the same month; however, for the adjacent region, the strongest relationships occurred 2 *months after* the injections. There was no significant correlation between ALP beyond 450 km and fluid injection. These results suggest that the same stimulus (fluid injection) that evoked earthquakes also evoked ALP. Our most recent analyses (Derr and Persinger 1990b) have demonstrated that some process, coupled to the production of ALP, was diffusing away from the injection site at speeds between 50 and 100 km/month to distances as far as 300 km.

(f) Visualization of the Moving Strain Field

Fields are difficult to perceive and must be both inferred and revealed by discrete effects upon matter. For example, the presence of the field between the poles of a magnet is not obvious until its effects on the orientation of iron filings are observed. The passage of a low pressure air mass is not apparent until one constructs the daily isobars (lines that connect stations with similar barometric pressure). If strain fields exist, they would be apparent by viewing the weekly or monthly changes in the numbers of ALP in space as the field moves through the crust.

In both the Uinta and Toppenish episodes, where earthquakes occurred in a quasicircular distribution around the concentration of ALP, they occurred primarily in the period between a seismic event on one side of the circle and a subsequent earthquake on the opposite side. This effect might be explained by the movement of a strain field; while moving between stress-release (epicenter) points, it traversed

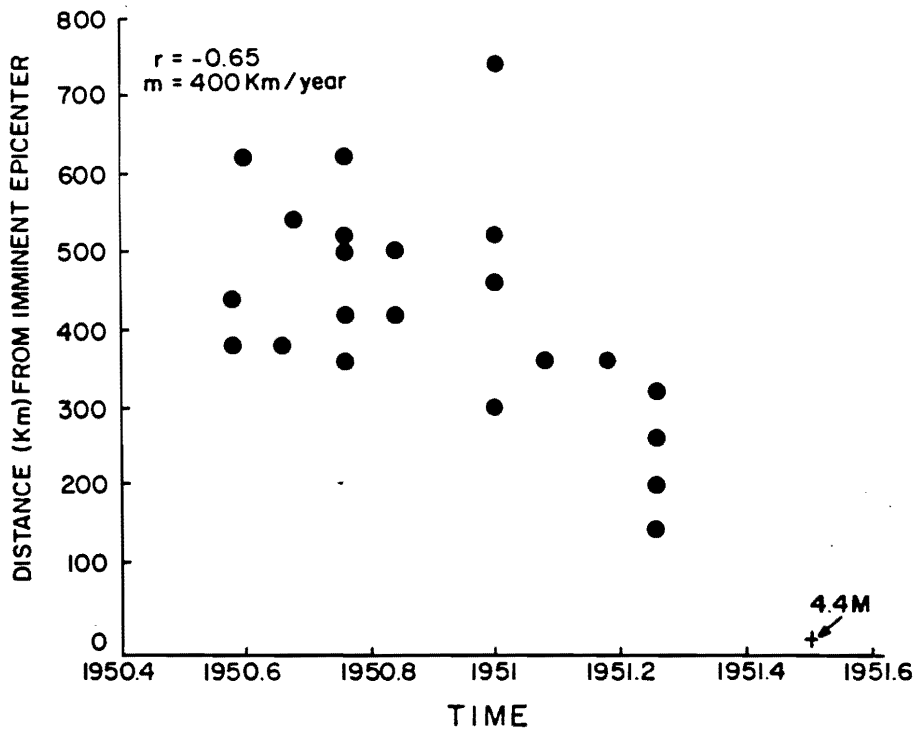

Figure 8. Distance of anomalous luminous phenomena from the imminent epicenter of a larger earthquake within New Mexico during the year preceding the release of seismic energy.

through the focal area and generated the ALP. Once the field passed through the area, the ALP were no longer produced and consequently UFOs were no longer reported.

The concept of a strain field existing around an epicenter is supported for *some* larger earthquakes. Earthquake lights are known to occur at distances of approximately 500 km from the epicenter of more intense seismic events. However, a moving strain field that converges upon an imminent epicenter would be more convincing. This pattern has been shown for some larger magnitude events. As can be seen in Fig. 8, the distance between all ALP in the region and the imminent epicenter (near Tucumcari, New Mexico) gradually decreased over several months. For another intense seismic event within that region (Los Alamos) there were no ALP within 100 km of the imminent epicenter 15 to 21 months before the quake. Ten ALP were observed during the period 7 months to 14 months before quake. However, about 50 ALP were reported during the six-month period that preceded the quake. After the quake, there were significantly fewer ALP and their distribution was totally random.

Of course the movement of a field-like pattern could have an alternative, geophysical explanation. One, as suggested by John Derr, involves the movement of ground water. Lateral movement and percolation of the massive fluid reservoir through the

:arth's crust can certainly affect the distribution of forces along fault lines. Alterations n the distributions or levels of ground water, especially along river systems in response to load extremes (floods), could affect these forces in a manner that would be very similar to that proposed for moving strain fields. Maintained injection of fluids, such as within the Derby site and many major oil fields, might also be expected to influence hydrodynamic factors. It is important to emphasize that at least in the Derby case, both the numbers of ALP and the numbers of earthquakes within the same month were most strongly correlated with the volume (in millions of gallons per month) of fluid injection.

(g) Limitations of the TST

There are reliable relationships of moderate strength that exist in time and space between numbers of UFO reports and the amount of seismic energy release within a geological region. Because both types of discrete events are produced by tectonic stress and strain and they are not directly measured but only inferred, the TST has not been demonstrated conclusively. The situation is analogous to the relationship between a fever and the later development of influenza. Although both the fever and the flu are produced by a virus, the association between the two is limited unless both can be related to the virus. The pattern may display strong reliability, i.e., there is a systematic positive lagged correlation between the fever and then the flu. However, the pairing does not necessarily demonstrate the validity of the hypothesized relationship: the virus causes both. The limit of the TST is analogous.

Most of the evidence that supports the TST is based upon correlational analyses and procedures that require a moderate level of appreciation for multivariate methodology. This feature is shared by many other areas of science, including epidemiology, meteorology, astronomy, and, of course, seismology. The temporal and spatial correlations between UFO reports and earthquakes are comparable to the association between:

1) radon levels and lung cancer;
2) alterations in stratospheric constituents and global warming, and
3) foreshock patterns and seismic events.

Sometimes phenomena that involve statistical processes are difficult to perceive and, for some researchers, frustrating to understand.

The role of cognitive style in problem solving and the frequent incompatibility between discrete and probabilistic thinking are important variables in this area of research. For example, one experienced exploration geologist felt that for the TST to be totally supported, *each* ALP should be shown to be associated with a particular earthquake. Such an approach is comparable to attempting to equate each cough with a particular spot during an episode of measles. Like any field phenomenon, some measure of the field's property rather than its individual constituents is essential.

The third major limit of the TST is the subject matter. UFO reports are based upon human observation. Consequently, issues such as sampling, estimates of how many

true UFO *events* are represented by a single UFO report, and the general problem of consistent recording of odd events (even an anomalous event becomes routine if displayed frequently enough) are potential sources of variance that affect the magnitude of the relationship between UFO reports and earthquakes. It is likely that if these errors were minimal, the relationship between ALP and earthquakes would be so conspicuous that statistical treatment would not be required. Sampling errors generally dilute, not enhance, the strength of replicable relationships.

An important difficulty with UFO reports is that they probably represent heterogeneous phenomena. Whether or not: 1) unidentified lights moving in a straight line, 2) rotating red balls of light with multiple smaller balls along their periphery, and 3) metallic-looking shapes originate from different sources of variance or are different manifestations of the same source (tectonic strain) must still be established. The presence of this heterogeneity suggests that single UFO cases cannot be used to refute either the phenomena (in the tradition of Philip Klass) or the TST (in the tradition of Stanton Friedman).

Whether or not UFO reports in one part of the world are comparable to those reported in another must still be addressed. Indirect evidence suggests similarity because historical episodes of increased global seismicity have been associated with "world-wide epidemics of luminosities." In North America there has been consistency in the proportion of different types of UFO reports within the Uinta, Rutledge, Yakima (Toppenish) and CUFOS collections. Most classified UFO reports are odd luminosities, comparable to CUFOS' classification Type III through Type VI; the stranger observations constitute less than about 5% of the population of reports. The strongest correlations occur between classic ALP and earthquakes; the stranger the observations, the less clear is the association to imminent seismic activity.

From an extreme behaviorist perspective, the persistent correlation between UFO reports and seismicity may only suggest that anomalous human behavior (in the form of strange perceptions) may precede earthquake activity in the region. Escalations of UFO reports could be considered as a type of epidemiological phenomenon that is analogous to other forms of odd animal behavior that may precede some earthquakes. This hypothesis can only be excluded when construct validity between UFO reports and other measures, e.g., photographs, spectral analyses, has been completed.

Mechanisms and Features of the Specific UFO Event

(a) What is the actual UFO event?

The logical extrapolation from the TST is that the individual UFO event, primarily an ALP, is the transformation of the energy associated with mechanical deformation within the earth's crust into electrical, light, magnetic, sonic, or even chemical forms. The transformation is in principle similar to the transduction of any energy. However, because the earth's crust is composed of heterogeneous materials with different thermoelectric, piezoelectric, and chemical compositions, the conversions are more

varied. This multivariate factor predicts that *a variety of different physical mechanisms are involved with the generation of UFO events.* If different mechanisms generate different products, then the rich variation in the physical properties of UFOs might be explained.

Despite this multiplicity of mechanisms, there should be predominant modes of transformation because the earth's crust displays larger percentages of certain types of minerals. Because quartz-containing rocks are so widely distributed, the piezoelectric form is one possible mechanism. An equally common process would involve a variant of the nucleation reaction that is hypothesized to precede earthquakes. Considering the magnitude and forces involved, one would predict that most UFOs generate substantial electromagnetic fields that include the entire spectra of light (and color), biologically hazardous ionizing radiation, and even quasistatic magnetic field components that are sufficient to affect lighting and ignition systems.

No direct extrapolation from the TST can predict what actually happens when the **quantum of strain** is translated into the phenomenon that is then perceived as a UFO. Does this quantum of stress translate into a microearthquake? Is the gradual increase in stress before its catastrophic release (e.g., an earthquake) associated with an escalation in the numbers of microearthquakes and hence the "release" of UFO phenomena? Or, is the quantum of strain transformed into the UFO event in lieu of the release of mechanical energy? What is the ratio of transformations of quanta of strain that are directly observable, i.e., are the (visible) UFOs only a *small fraction* of the actual numbers of strain quanta? Are the others released as pockets of radon gas or electromagnetic radiation? There are no contemporary answers to these questions.

The physical properties of the UFO event should reflect some fundamental feature of the local earth's crust and the mechanism through which the ALP is generated. We should find that the predominant red color of ALP should reflect a frequent chemical property that accompanies the transformation of the quanta of strain. The involvement of sulfide-based ores would be expected to generate sulfur-oxide or methylsulfonamide (the smell added to propane gas) correlative with the ALP. Involvement of outcrops of acidious quartz diorite might promote the release of the relatively common radioactive gas, radon, and evoke reports of "residual radioactivity." Enhanced gas emissions and chemiluminiscence have been postulated to generate at least some types of earthquake lights (Hedervari and Noszticzius 1985).

One would expect that measurable residues of ALP, when they touch the ground, should reflect the primary constituents of crustal material. The few metallurgical analyses that have been conducted revealed oxidized forms of the most frequent elements of common rocks: silica, manganese, and aluminum. Quantitative estimates indicate that only a few grams of metal (Persinger 1984b), dispersed along a strong electromagnetic surface, would appear as "metallic." Interestingly, the temporal association between some ALP reported during the 19th century and the deposition of "slag" or metallic fragments was frequently reported by Charles Fort. If the ALP had been labeled "spaceship," then these materials would be attributed to "spaceship fragments."

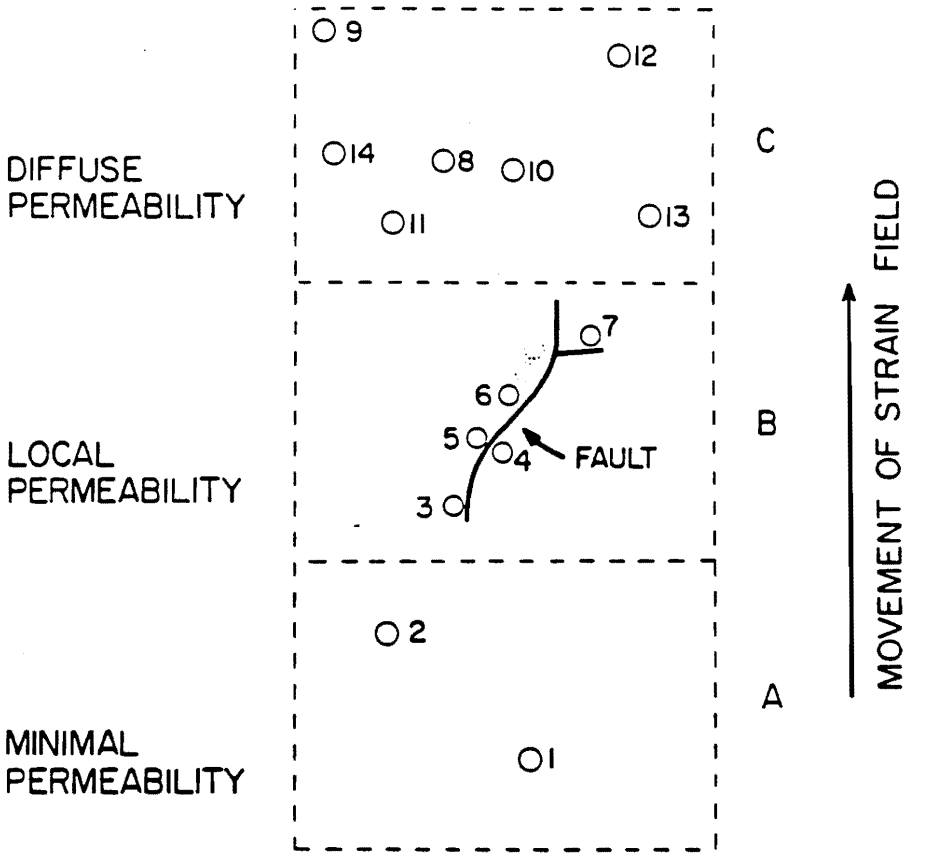

Fig. 9. Conceptual representations of the distributions of ALP and hence UFO reports as the strain field moves through different crustal architectures and compositions. (A) In areas of minimal permeability to strain induction, few UFOs are evident. (B) Within an area in which a fault line is present, most of the UFOs occur along its dimensions. (C) Within an area that is maximally permeable to strain induction, despite the absence of obvious fault structures, the UFOs appear statistically in a variety of specific localities. Although they are actually *different* events generated by the same strain field, they may be misperceived as the same event appearing and disappearing in different locations.

(b) Local Displays of ALP Should Be Distributed Around Areas of Stress Accumulation and Release But Be Attracted to Geometries that Promote Charge Collection

As shown in Fig. 9, the occurrence of specific ALP is predicted to occur in topographies that are associated with stress release. Consequently, LP should be more frequent along fault lines or their topographic equivalents such as rivers and creeks. To test this prediction, a comprehensive knowledge of the local structural geology would be required. The systematic pursuit of this hypothesis has been completed

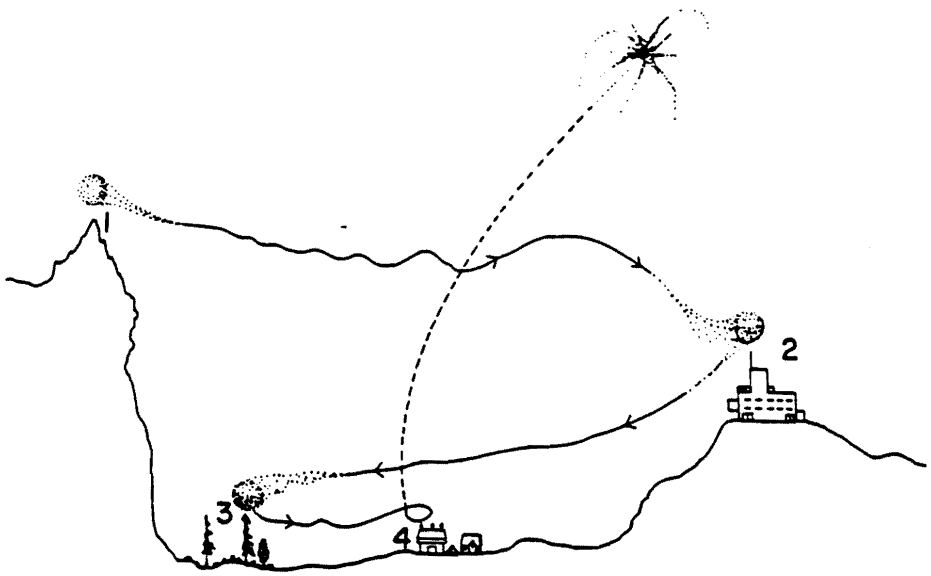

Fig. 10. Conceptual indication of the factors that affect the movement of the individual UFO event. In general, unless driven by a strain field, dynamics would be influenced by the balance of charge distribution and local conductive-dielectric topography. In this example, the event moves from the peak of a mountain to the antennae of a steel-reinforced concrete installation, over the tops of trees, and finally over a house. Either movement of the strain field or intrinsic instability within the UFO, indicated by a change in EM emission (color), results in movement away from the locality.

almost exclusively by Paul Devereux (1989) and his research group. They have shown that ALP are distributed along fault lines. In the U.S. the only comparable study involved the collections by Greg Long (1990) for the Toppenish Ridge ALP. There are likely to be hundreds of keen observers who have noticed the relationships between very local and brief displays of ALP, fault lines and seismicity. Without the implementation of Ron Westrum's (1982) concept of a social network, the presence of these observers would remain obscure.

If the individual UFO is primarily an electromagnetic phenomenon, it should follow those principles. Verification of this prediction would require classification of the natural and man-made structures of the local environment along a continuum of conductors to non-conductors (Fig. 10). Classic UFOs or ALP would be expected to occur over powerlines, near the apices of structures (towers, steeples, hills); they would also be attracted to moving semiconductors such as trains, cars and the human being. Although qualitative descriptions support the general hypothesis, well designed quantitative studies are required.

(c) Local Triggers of ALP Involve Any Stress-Relevant Stimuli

Although tectonic stress must be present to generate ALP, its acute occurrence will depend upon probabilistic processes or the occurrence of a trigger. If the former occurs, then UFO reports could be distributed in a less conspicuous manner over several days to weeks. However, there are several candidates that can affect local stresses and force the production of UFOs into narrower and more conspicuous temporal windows. Major triggers are: lunar tides, the passage of air masses and geomagnetic storms. All have been found to trigger earthquakes (Latynina and Rizaeva 1976; Kilston and Knopoff 1983). A focal strain field associated with the moon rotating around the earth travels at the order of 1,000 km/hr. Passage of air masses (Persinger and Cameron 1986), especially very energetic ones, have been associated with some UFO flaps, ghost lights (such as the Hookerman phenomenon in New Jersey) and earthquake lights (Yasui 1974). The role of intense geomagnetic storms was discussed in the last section.

(d) The Strangeness of the Individual UFO Event Reflects the Perspective of Observation

Strangeness or unusual properties frequently emerge when a phenomenon's level of discourse is traversed. At the level of 10 cubic centimeters a glass of water containing lipid membranes appears clear and homogeneous. Within a 1 cubic nanometer volume of that same fluid, odd and unusual properties emerge. There may be some (hydrophobic) regions where there are no water molecules; in other regions the electric charge disparity may be equivalent to a million volts per meter and protein chains may twist and rotate continually. The phenomena are anomalous because the observer has traversed a level of observation and is perceiving an extremely minute subset of the total set.

An analogous situation is predicted to be responsible for the fundamental strangeness of many UFOs. Because the observer is viewing a minute subset of the tota phenomenon (the strain field), properties are apparent that would not be discernible at a regional level. This prediction is more metaphorical then empirical. However, i opens the possibility for the discovery of unusual physical forces or their anomalous application and perhaps unexpected interactions between the electromagnetic correlates of human cognitive processes and the UFO phenomenon itself.

(e) The Observer's Beliefs Affect the Description of the UFO

Most UFO phenomena are measured by complex human processes that involve sensation, perception and memory. They are affected by the person's expectations, beliefs, and learning history. The more dependent the description is upon these processes, the more they affect the details of the original sensation. If the label spaceship is used to label an ALP, the recalled details can slowly change from a bright light in the sky to an object with windows, to a craft. Because memory is the

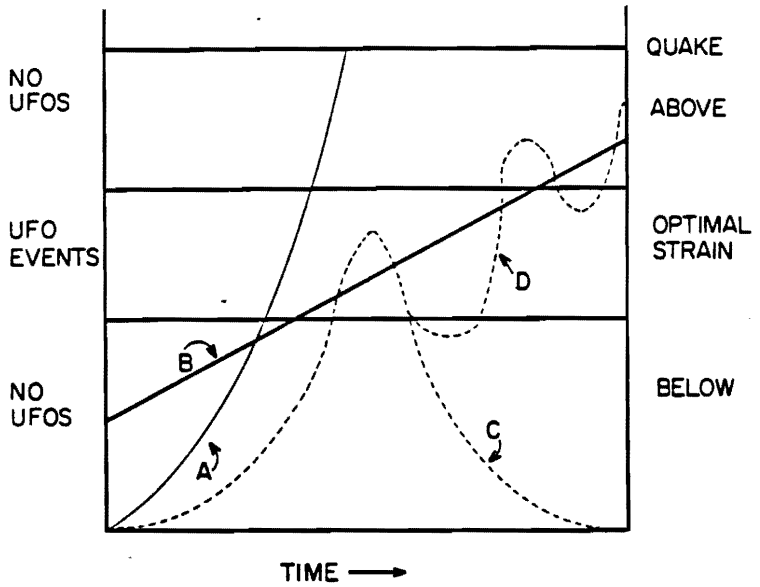

Fig. 11. Graphic representation of the hypothesis that ALP are generated when only specific parameters of tectonic strain are present. Below or above this optimal condition, no UFOs are generated although other forms of unusual events may occur. Depending upon the rate of strain accumulation, the duration and numbers of ALP and UFO reports will change. (A) Strain increases rapidly, evoking multitudes (and hence conspicuous numbers) of UFOs before an earthquake is precipitated. (B) The strain increases in a linear manner such that the ALP are distributed over several weeks before the occurrence of earthquakes. (C) The strain field increases, generates UFOs, but then decreases before it can generate an earthquake. (D) The strain field undulates such that a series of separate UFO episodes are generated.

"measurement" of experiences, the person cannot easily detect changes within the system. The fidelity of memory, especially for anomalous events, has been discussed elsewhere (Persinger 1983f, 1984b).

(f) Does the Increase in Stress Before Quakes Generate More ALP or Evoke Qualitatively Different Phenomena?

The general tendency for most UFO events to occur weeks to months before the release of seismic energy suggests that their temporal relationship is non-linear. If it were not, then more and more ALP should occur as the imminent earthquake approached. The absence of general linearity indicates that some restricted amount of stress or a particular rate of change in stress, early in the stress accumulation, is optimal for the generation of ALP (Fig. 11).

The analyses of the Washington-Oregon data (Persinger and Derr 1984) indicated that the greater the amount of energy release, the greater the temporal lag in the

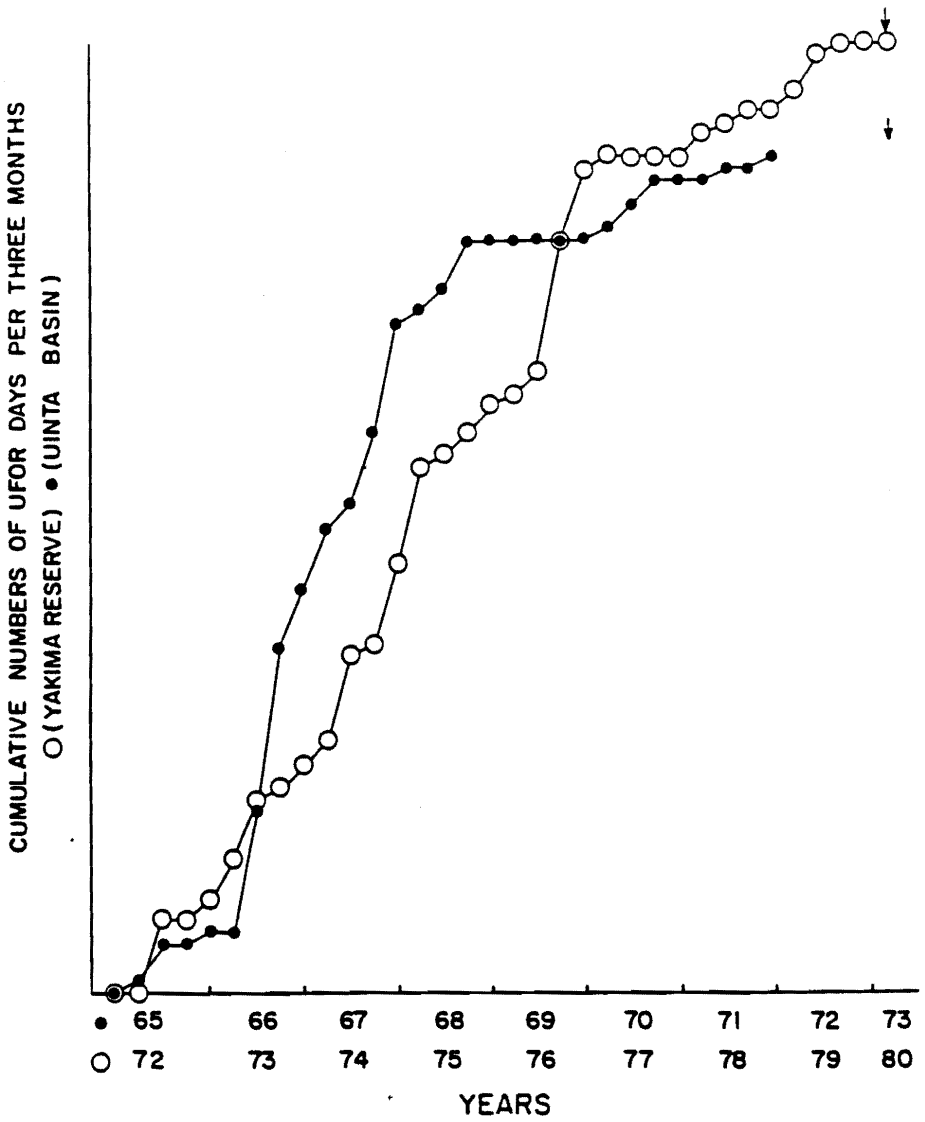
CUMULATIVE NUMBERS OF UFOR DAYS PER THREE MONTHS
O (YAKIMA RESERVE) • (UINTA BASIN)
• 65 66 67 68 69 70 71 72 73
O 72 73 74 75 76 77 78 79 80
YEARS

Fig. 12. Cumulative numbers of ALP or UFO reports per three-month increment within the Yakima (Toppenish) area in Wahington state between the years 1972 and 1980 and within the Uinta Basin, Utah, between the years 1965 and 1973. The records were aligned accoring to the putative major event (indicated by arrows). The major event for the Yakima area was assumed to be the Mt. St. Helens eruptions. Within the Uinta Basin, the event was two earthquakes on the same day. One of the quakes was 5.4 M and was the largest event that had been recorded in the Basin (at least between the years 1960 through 1983). Whereas the collection of the Toppenish data continued with only occasional discontinuities until the major event, the Uinta data ended in 1971.

antecedent peak in numbers of UFO reports. Peaks of ALP in the Zeitoun episode (Derr and Persinger 1989a) preceded the major seismicity by almost a year. In an analogous manner, temporal clusters of anomalous seismic activity may occur several years before the occurrence of a major shock (Yoshida 1987). These results suggest a "critical zone of stress magnitude" that could generate ALP. Depending upon the duration that this zone was maintained and the movement of the stress field, ALP could be generated for several weeks (with concomitant seismicity), but then become less evident for years before a significant *major event.* An example of this pattern is shown in Fig. 12.

Whether or not other kinds of anomalous phenomena are generated by tectonic stresses before and after this critical zone is not clear. Only one analysis has shown that electrical anomalies (power failures) precede ALP that in turn precede more exotic displays, such as poltergeist-like events. The conceptual and spatial concomitance of ALP with poltergeist, haunt, and other phenomena was observed in the Toppenish, Uinta, and Gold Hills, North Carolina (unpublished reports by Wayne Laporte), displays. The interrelationship between UFO and parapsychological phenomena has yet to be explored.

(g) Limitation of the TST Application to the UFO Event

Although there are many similarities between luminous phenomena generated by compressional stresses within the laboratory and the ALP that could be generated by tectonic strain, a mechanistic connection between the two is less clear. The fundamental assumption has been that laboratory models are valid representations of large-scale equivalents. This assumption is prevalent in many scientific disciplines. Unfortunately there have been no published studies by physicists or geophysicists that have applied the discrete relationships of the laboratory to the large-scale field setting. If the essential phenomena are scale invariant, then the lifetime of the average UFO suggests that compressional energies involve hundreds of square kilometers of crustal space.

The Close Encounter Problem

The issue of abductions by alien intelligence, whether manifested as the angels of the 16th century, the fairies of the 19th century, or space creatures of the present period, is not critical to the verification of the TST. These experiences involve no more than 1% of the total data set of UFO reports. However, the powerful association between the explanations of UFO phenomena and the occurrence of these unusual experiences requires objective attention.

(a) Contactee and Abduction Experiences are Variants of Beliefs in Mystical Entities and Cosmic Experiences

The experienced clinician is cognizant that the concept of the human self is a fragile phenomenon whose integrity is maintained by systematized beliefs and expectations. They produce the sense of personal purpose and facilitate the creation of strategies that diminish the apprehension of personal death. Belief in omnipotent forces such as God or more contemporary equivalents, such as alien intelligence, is one obvious consequence of these processes. An indication of the intimate relationship between these beliefs and the integrity of the self is the anxiety, anger, and flurry of verbal activity that are evoked when the beliefs are challenged. Such systematized beliefs are so common that by definition they are normal. Beliefs that dominate a person's life are considered delusions only when they deviate extremely from culturally acceptable concepts. Psychologically, there is no difference in the belief that God protects a person from harm and the conviction that Omnipotent Space Creatures are spiritual custodians.

Anxiety, depression and dissociation are common features of everyday life. Although the prevalence of the first two are apparent, the incidence of dissociation is less widely known. The intensity of symptoms range from the occasional "staring into space" to large periods of missing time. Approximately 10% of the population dissociates frequently and at least half of the population dissociates during intense personal events, such as divorce, death, and occupational disappointments. During these periods the person may experience missing time and report alterations in memory. Memories can be reorganized such that they are no longer accessible to consciousness. When this occurs the concept of self is sometimes changed; in more religious traditions the period coincides with conversions.

If a specific stimulus was associated with dissociation, then a later presentation of that stimulus or something similar to it can activate these alterations in memory. Because these "altered memories" are often odd or personally unacceptable, their revelation generates anxiety; consequently there are strong psychological forces that prevent their emergence. The person may remain vigilant (anxious) or display depression. During periods of personal stress, these dissociated memories, modified by beliefs and expectancies, occur as experiences that are perceived as originating "outside" of the self. These experiences are perceived as real and are frequently ascribed to religious or mystical intervention. The consequent conversion in cognitive structure, alters the perception of the self and the sense of purpose.

(b) Anomalous Experiences that Comprise Contactee and Abduction Reports are Correlated with Enhanced Activity within the Temporal Lobes of the Human Brain

Although all portions of the brain are involved with experience, the temporal lobes have a major contribution. These regions contain the most electrically unstable structures of the brain; they are strongly associated with meaning, memory, visual and auditory imagery and the sense of self. Extreme electrical stimulation within these

regions is associated with altered perception of normal events, the release of dream states into consciousness, feelings of personal destiny, concerns about the meaning of life, the compulsion to proselytize, and an intense widening of affect such that mundane observations, from a crescent moon to a misplaced bracelet, become components of a common theme (Persinger 1983f).

The lability of temporal lobe activity displays a continuum; people who display limbic epilepsy, defined by focal electrical seizures that may or may not generalize to motor convulsions, occupy the extreme end of this continuum. Most normal people would show intermediate forms of activity. However, this can be enhanced by physiological states, particularly those associated with elevations in the stress neuropeptides adrenocorticotrophic hormone (ACTH) and the glucocorticoid, cortisol (Persinger 1989).

The personalities of normal people who display enhanced temporal lobe activity are dominated by its features. These people usually display enhanced creativity, suggestibility, memory capacity and intuitive processing (Persinger and Makarec 1987). Most of them experience a rich fantasy or subjective world that fosters their adaptability. Many of them are prone to bouts of physical and mental activity followed by mild depression during which self-questioning occurs. These people have more frequent experiences of a sense of presence during which time "an entity is felt and sometimes seen"; exotic beliefs rather than traditional religious concepts are endorsed. With the exception of panic and post-traumatic stress disorders, there is no evidence that the incidence of psychiatric disorders among people who display temporal lability is any greater than those less prone to this activity. The delayed emergence (15 years or more after the enhanced lability) of schizophreniform processes cannot be excluded.

(c) Any Event That Fosters Dissociation and Focal Temporal Lobe Activity Might Precipitate Contactee or Abductee-Type Experiences

Most human cultures have developed techniques that facilitate periods of contact with and "abduction" by mystical entities. The common factor of these techniques is the capacity to encourage temporal lobe lability: fasting, hypoxia, and psychological or physical stress are effective stimulators. Their general consequences are similar. With the details of culture removed, there is little difference operationally between an American Indian encountering his spirit guide and being taken to "the land of the spirits" and the 20th-century North American encountering an alien and being abducted. The fragmented memories, parapsychological themes, missing time, episodes of torment or inspired "messages" and sense of personal significance remain the same.

Because most UFO phenomena are assumed to be energetic natural sources, close proximity to them would preferentially evoke electrical instability within the observer's brain (Persinger 1983f). The types of symptoms and their intensity would vary as a function of the current induction within the brain. As the current density increases, the consequences would change from tingling sensations or sense of a

presence, to odd smells or sounds and then to the release of dream-like images. At very intense currents, partial amnesia might occur and severe hypertonus or convulsions would ensue. Very intense currents would be lethal; unless precise postmortems were completed, the symptoms would simulate a heart attack. If the body was associated with burns, death would probably be attributed to a lightening strike.

Even though disruptions in consciousness would occur, memory would still be consolidated. It would be affected by the label and the beliefs evoked by the person to describe the ALP just before the stimulation. Once the neuroelectrical equivalents of these experiences occurred, a process that involves only a few minutes, the memories would appear as real as those acquired under more mundane conditions. Any form of extraction, from free association to hypnosis, would simply reflect what the person believed happened rather than what necessarily occurred. Considering the predictable manner in which neurocognitive processes adjust to brain trauma, alterations in the "retrieved" experiences or "revelations" should be evident as cognitive dissonance is resolved and information acquired *after* the incident is incorporated into memory. These processes have been demonstrated experimentally in a variety of psychological contexts (Stern 1985; Rossi 1986).

There are important differences between the effects of current induction that can occur proximal to an ALP and those evoked by more mundane sources, such as electroconvulsive shock (ECS). The latter is quick, discrete and occurs within a relatively familiar context. The experimental procedure that evokes experiences most similar to the more extreme UFO encounters is the electrical stimulation associated with neurosurgery. It involves very focal current induction (about 1 cc) within the brain (Persinger and Cameron 1986). These similarities suggest that the magnetic fields associated with ALP involve highly localized, flux line-like distributions of energy. Most medical utilizations of electromagnetic energy, such as magnetic resonance imaging (MRI) techniques, are not representative of this process because they emphasize homogeneity of current distribution.

Because ALP generated by tectonic strain could affect the brain of the nearby observer, some abduction and contactee experiences might be attributable to this source. Considering the variety of psychological and physiological conditions that can affect temporal lobe lability, the majority of these experiences should not involve ALP directly. They would be the subject matter of the experts who study human cognitive processes. In light of the strong correlation between lifetime histories of dissociation during stress and early histories of sexual and physical or psychological trauma, especially between the ages of 4 and 6 years, these factors would be expected to predominate. For these cases, the TST is simply not applicable.

Some Important Considerations if the TST is Valid

(a) The Role of Belief in UFO Research

The only relationship between UFO phenomena and alien intelligence is that both concepts are strange. Although UFO phenomena are veridical and alien intelligence somewhere in the universe is probable, there never has been any evidence that the two are related. A connection between a "crashed vehicle" and the millions of UFOs displayed as ALP is even less likely. For centuries now, some form of "extraterrestrial" intelligence has been the default explanation for anomalous events that appear in the sky. ETI for UFOs is an empty hypothesis because the intelligence is functionally defined, like the existence of God, in a manner that can never be tested by traditional scientific methods.

With each added anomaly to UFO phenomena, the description of alien causality becomes more and more bizarre. One believer in the alien hypothesis commented that even if the correlation between UFOs and earthquakes was perfect, it would only show that spaceships are following faults lines in order to obtain energy to traverse the fourth dimension. No amount of analyses can compete with intense belief.

However, if it were not for such beliefs, tenaciously defended with sometimes religious fervor, the UFO data now available would never have been collected. These researchers were like the early astrologers who obsessively recorded the positions of the planets in order to find their personal future. If those data had not been collected, one wonders if Tycho Brahe and Johannes Kepler would have had the database to test their theories of the physical solar system. Without the dedicated believers in extraterrestrial surveillance, government conspiracies and ultradimensional intelligence, UFO data would not have been collected systematically. Inductive hypothesis, such as the TST, could not have developed. The history of science will probably reference them for their perseverance as the data collectors.

The emergence of the TST and other testable competitive hypothesis will no doubt begin, sooner or later, to erode this belief. The systematic collection of data will subside and the empirical pursuit of the phenomena will falter. Science will not necessarily compensate for this deficit because scientists are human beings whose behaviors are also governed by belief. At present the study of UFO phenomena is believed not to merit scientific inquiry and remains in the realm of personal belief. The mentality is reflected in the comments by an anonymous referee who reviewed a manuscript by John Derr and me. The referee wrote: "The relationship between ALP and the release of seismic energy in the central U.S.A. is only correlational and if I had a choice I prefer to believe that they are alien spacecraft rather than caused by tectonic strain."

If the strength of association between two phenomena of such great potential importance, such as UFOs and earthquakes, were found in physics, medicine or astronomy one doubts if the potential would be ignored so conspicuously. However, until UFO phenomena are divorced from their association with concepts that are

couched within personal beliefs, pursuit of understanding will remain in the periphery of science. Only a few protagonists and antagonists will remain, often at risk to their own reputations.

(b) Medical Concerns and Implications

There are two major implications of the TST that deserve ethical consideration. First, if most UFO phenomena are generated by tectonic stresses and they are associated with the release of anomalous electromagnetic fields and radioactive gases, should epidemiological studies be recommended (Persinger 1988b)? There are dozens of anecdotal cases of untoward biological effects, including premature mortality, following close proximity to intense ALP. The known population has ranged from the most frequent experients of the Fatima episode to the Cash-Landrum radiation case. Most UFO researchers are informed of at least one local case of a person becoming ill or dying shortly after close proximity to an anomalous light, especially when missing time is concomitant.

These cases are likely to be the extreme representations of exposure to the electromagnetic correlates of the processes that generate UFO phenomena and ALP. Experimental data clearly indicate that even weak time-varying magnetic fields can affect DNA activity and cell division (Liboff et al. 1984). The weak but significant relationship between cancer, including brain tumors, and certain types of EM fields cannot be denied (Persinger 1988b). If most UFO events are associated with potentially hazardous forces, then risk assessment is a responsibility rather than an option for the cognizant scientist.

Of course, a prudent balance between concern and prevention of undue alarm is essential. Except in cases where there are multiple close encounters with ALP or in certain "flap" areas where maintained concentrations of ALP occur over time, the risk of health hazards will probably be minimal. Perhaps the question is best phrased by a specific possibility. Who will be responsible for the child who is seriously affected by a close encounter to an ALP because he or she thought it was Spielberg's ET, returning?

The second consideration involves the psychological status of abductee and contactee experients. The majority of these individuals should be psychiatrically normal. The stress of an anomalous experience can be comparable in impact to that associated with the confrontation of the memories of sexual assault or abuse and should be treated by a mental health professional. If the TST is appropriate for most ALP, then the belief concerning abductions and contactee by alien intelligence is delusional. The encapsulated "abduction experience" is no more real or unreal than the demons and aliens that compose the "alters" (dissociated behaviors and memories) of patients who display multiple personality disorders (Ross 1989). Confrontation with delusional origin to the alien experience can be as devastating to the person's psychological state as proof that God is fantasy might be to a religious believer. Within this context, the ethical bases of researchers who embellish and encourage the abductee's beliefs are challenged.

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